Frequency and Physical Characterization Of Pelog Gamelan By Reni Maestro Malang Mask

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Abstract. This study aims to determine the frequency and physical form of bronze gamelan with pelog barrel by Malang mask puppet maestro Mbah Reni. Data obtained by recording sound with Da Tuner software and analyzed with the analysis facility in the program, so that the sound frequency is obtained. The results showed that the frequency of each tone was different. The lowest tone frequency was on gong with a frequency of 103.63 Hz and the highest frequency was 1978.83 Hz on peking instruments. The ratio of frequencies to n and n = 1, 2, 3, 4, 5, 6, 7 on average is 856. **Keywords**: *frequency, gamelan, wayang topeng malang*

1. Introduction

Gamelan is one of Indonesia's traditional musical instruments that has gone global. Gamelan can be equated with ethnic musical instruments from various countries, including Djembe Drumming (Africa), Capoeira Dancing (Brazil), Samba (Brazil), Taiko Drumming (Japan), or Didgeridoo (Australia) [1]. Besides, gamelan instruments are also studied in various universities such as in America, Europe, Japan, Australia, New Zealand, Canada, Germany, France, Belgium, Israel and other parts of the world. In the Netherlands, an International Gamelan Conference was held in 2007 which discussed the development of gamelan music both in Indonesia and around the world [1]. So it cannot be denied that our cultural heritage has truly been recognized in the eyes of the world.

Javanese gamelan instruments are the work of maestros, composers or music artists. In making Javanese gamelan, the most important thing to pay attention to is to give inner satisfaction to every audience. Javanese gamelan made in its presentation must be able to get the spirit of music (spirit). Music soul (soul) is an expression of the sense of hearing that affects the power that comes from within because the presentation of music is intangible in a visible physical form, but only has the power to touch the feelings of the musicians (musicians), the feelings of the audience or listener. This is by Marc Benamon who said the following:

Råså (in music) may also be translated as “sensation” or “inner meaning.” But it sometime means “the ability to express or percive feeling or inner meaning,” or “the faculty through which these are perceived” (“intuition”). [2].

The process of making gamelan is a process that requires a fairly in-depth scientific study. The main components that influence the manufacturing process are the selection of bronze composition mixtures, the casting process, the forming and compaction (forging) process, the heat treatment process and the finishing process. The bronze used is a mixture of copper (Cu) and tin (Sn). Each gamelan note has a specific pattern in its interval size. So, instruments from one set of gamelan cannot be played on another set. In other words, there is no standard tone. Each gamelan has its own sound characteristics [3].

In Malang, there is an ancient gamelan that has a history similar to the development of Wayang Topeng Malang. The gamelan in question is the Gamelan Pelog which is now in Mrs. Sadana's residence. This gamelan is the work of a Malang Mask Maestro who was passed on to his grandson Kangsen. The source of the search for gamelan is based on Onghoham's research which states that

"Reni had another brother Nita, who was equally famous as a wayang kulit carver. As neither Reni or Nita left sons, Reni's daughter sold Reni!s famous gamelan as well as the wayang topeng and wayang kulit business after their deaths to the relatives at Djabung, Kangsen and a brother-in-law of Kangsen, who is well situated and has a wayang purwa business. The two relatives jointly own the Reni gamelan and are in fact business partners [4].

After going through the process of tracing Reni's ancient gamelan, he is now at Mrs. Sadana's house which is located in Karangploso District. Currently, Reni's gamelan is intact, but some of the blades have undergone a reset process. To determine the potential loss of the image of the gamelan sound which is a representation of the work of a maestro, this research was conducted. Based on the background and existing problems, this study aims to determine the physical form of ancient gamelan in Malang City and to determine the resonance frequency value of each gamelan instrument with the help of digital instruments.

2. Methods

2.1 Tool Calibration Schematic

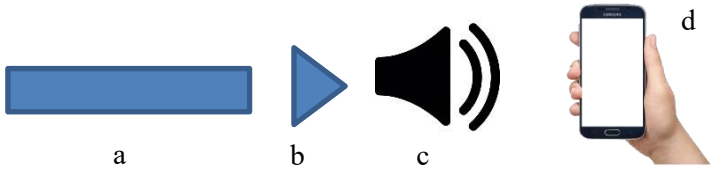

Figure 1 Schematic of Tool Calibration. a. Function Generator; b. Amplifier, c. Speaker, d. The LG V20 phone comes with Da Tuner software.

The calibration scheme is shown in Figure 1. The Da Tuner software is calibrated with a function generator. Calibration is done by comparing the frequency value generated by the function generator with the frequency value read in the Da Tuner software. Tool calibration was carried out by researchers to test the accuracy of the software to be used to obtain the desired frequency data results. The cellphone used is the LG V20 which is one of the phones that has advantages in terms of audio.

2.2. Experiment Scheme on Data Collection Saron Demung

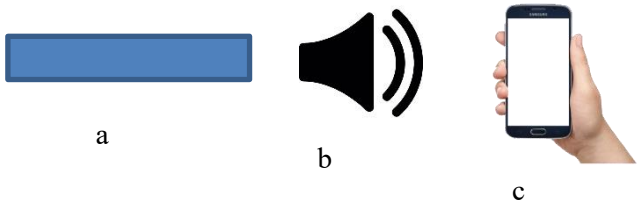

Figure 2 Experiment Schematic on Saron Demung. a. Saron Demung Laras Pelog; b. The resulting sound, c. LG V20 mobile phone equipped with Da Tuner software.

Figure 2 shows a schematic of the experiment carried out to retrieve and store experimental data from saron demung. Experiments were carried out to measure the distance needed to obtain accurate distance data, obtained accurate gamelan sounds obtained at a distance of 41 cm.

2.3 Scheme of Gamelan Musicians

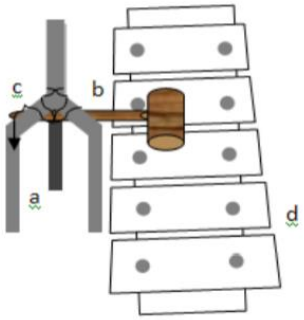

Figure 3 Schematic of the Saron Demung Laras Pelog drummer. a. Static iron; b. Wood Beat; c. Tire Strap; d. Saron Demung Laras Pelog.

Figure 3 is the schematic of the musicians in the Saron Demung area. Data collection for each gamelan area was carried out 50 times with the pressure on the percussion considered constant. The Da Tuner software pre-installed on the Lg V20 phone is placed near the observed area. The resonant frequency value can be read directly on the frequency meter column.

2.4 Gamelan and Room Arrangement

The arrangement of the gamelan and the room was left to the gamelan pin with the name Misdi, which is the belief of Kansen, the owner of Reni's gamelan, before finally changing hands to Mrs. Sadana. This arrangement aims to obtain a frequency and atmosphere similar to that in the Reni era. Gamelan is a unitary musical instrument that cannot be separated, sometimes when playing bonang, there will be other gamelan sounds that are measured, this is true because gamelan was not created as a single musical instrument but as a set of musical instruments.

3. Result and Discussion

The research data were obtained from gamelan sound recording and gamelan measurements. Gamelan set sounds are recorded using the LG V20 Mobile device.

3.1 Calibration Results

To obtain data accuracy in the study, a comparison of fFG and fVA was carried out as shown in the calibration result graph in Figure 4. The resulting linearity equation is then used to calculate the frequency value of the research result.

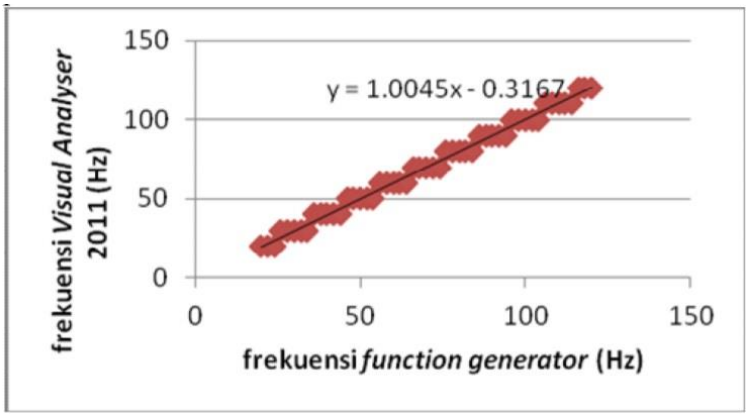

Figure 4 Results of Tool Calibration with a function generator

Rum us and the Calculation of Resonance Frequency Values and Research Resonance Frequency Uncertainty with m = 1.004, Δm = 0.001, ΔfVA = 5, c = 0.316, Δc = 0.003.

$$f_{VA} = 1{,}004 f_{FG} - 0{,}316 = m f_{FG} - c$$

$$f_0 = f_{FG} = \frac{f_{VA} \mid 0{,}316}{1{,}004} = \frac{f_{VA} \mid c}{m}$$

$$\Delta f_0 = \sqrt{(\frac{\partial f_{FG}}{\partial f_{VA}} \Delta f_{VA})^2 + (\frac{\partial f_{FG}}{\partial m} \Delta m)^2 + (\frac{\partial f_{FG}}{\partial c} \Delta c)^2}$$

$$\Delta f_0 = \sqrt{(\frac{1}{m} \Delta f_{VA})^2 + (-\frac{f_{VA}}{m^2} \Delta m)^2 + (-\frac{c}{m^2} \Delta m)^2 + (\frac{1}{m} \Delta c)^2}$$

Figure 5 Formulas and Calculation of Resonance Frequency Values

3.2 Frequency Results in Reni's Gamelan

Table 1 is the frequency data measured in Gamelan Reni. For some tones that have a pitch deviation based on the assumption of the researcher being marked in bold, this is done so that frequencies that are deemed deviant are not used as a reference and can be removed later. The data displayed is not all gamelan but includes Gong, Kempul, and Bonang. This is because the three gamelans represent a picture of the gamelan frequencies by Reni as a whole.

Data number (1) is data obtained using the Da Tuner application using acquisition according to the order described in points 2.1-2.3. Data number (2) is data obtained using the Spectroid application with a sampling arrangement scheme, namely: Sampling rate 44100 Hz, Processing FFT Size 2048 BIN (22 Hz / BIN), Decimation 5 (0.67 Hz / BIN @ DC), and Transform 20 ms (50 Hz) intervals. Data number (3) is obtained using the Blue Paint Frequency Analysis 2. In data numbers 2 and 3 the analysis is carried out by analyzing the results of the recorded voice that has been recorded during the direct frequency measurement process using Da Tuner. The use of these three models is carried out to get an impression of the sound frequency that matches the conditions of the gamelan when the maestro Reni was still alive.

Table 1 Frequency Data on Gamelan by Reni.

No.	Tool	(1)	(2)	(3)	Average
1.	Gong	102	100.9	108	103.63
2.	Kempul	127	124.4	129	126.8
3.	Bonang Barung (*Laras* $\dot{1}$)	286	286.2	281	284.4
4.	Bonang Barung (*Laras* $\dot{2}$)	306	306.3	301	304.43
5..	Bonang Barung (*Laras* $\dot{3}$)	328	328.9	323	326.63
6.	Bonang Barung (*Laras* $\dot{4}$)	386	385.9	387	386.3
7.	Bonang Barung (*Laras* $\dot{5}$)	416	416.5	409	413.83

8.	Bonang Barung (*Laras* 6̣)	437	437.4	431	435.13
9.	Bonang Barung (*Laras* 7̣)	491	491.4	496	492.8
10.	Bonang Barung (*Laras* 1)	572	572.1	574	572.7
11.	Bonang Barung (*Laras* 2)	608	608.6	605	607.2
12.	Bonang Barung (*Laras* 3)	658	658.6	660	658.86
13.	**Bonang Barung (*Laras* 4)**	**762**	**761.5**	**756**	**759.83**
14.	Bonang Barung (*Laras* 5)	832	832.7	839	834.56
15.	Bonang Barung (*Laras* 6)	877	877.3	881	878.43
16.	Bonang Barung (*Laras* 7)	988	988.8	992	989.6
17.	**Bonang Penerus (*Laras* 1)**	**567**	**567.2**	**558**	**564.06**
18.	Bonang Penerus (*Laras* 2)	612	613.4	610	611.8
19.	Bonang Penerus (*Laras* 3)	659	660.1	665	611.36
20.	**Bonang Penerus (*Laras* 4)**	**759**	**760.3**	**755**	**758.1**
21.	Bonang Penerus (*Laras* 5)	837	837.1	839	837.7
22.	Bonang Penerus (*Laras* 6)	880	879.1	883	880.7
23.	Bonang Penerus (*Laras* 7)	991	992.3	992	991.76
24.	Bonang Penerus (*Laras* 1̇)	1155	1154.6	1160	1156.53
25.	Bonang Penerus (*Laras* 2̇)	1235	1235.5	1239	1236.5
26.	Bonang Penerus (*Laras* 3̇)	1338	1337.5	1339	1338.16
27.	Bonang Penerus (*Laras* 4̇)	1572	1572.4	1575	1573.13
28.	Bonang Penerus (*Laras* 5̇)	1663	1664.7	1663	1663.56

29.	Bonang Penerus (*Laras* $\dot{6}$)	1841	1840.0	1841	1840.66
30.	Bonang Penerus (*Laras* $\dot{7}$)	1960	1958.3	1963	1960.43

3.3 Comparison of Research Results with Reference

Based on the observed size of each pelog gamelan tuning, the width of each area, and the same thickness assumption, it can be seen that the smaller the area, the greater the value of the resulting resonant frequency. This shows that it is true that with the resonant frequency and L is the field width [1,2], the resulting resonance is different. This is due to many factors that influence the tone of the gamelan, namely the quality of the materials used, the wood used as the *pangkon* board, the age of the gamelan, and most importantly the resonator holes under each region. The resonator functions not only as a place for air resonance to occur but also as an amplifier for the sound resulting from the vibrations generated by the beating of the gamelan on it.

From each observation area, the mean value of the resonant frequency is shown in Table 1. To determine the frequency position of the Maestro Reni gamelan, a comparison was made with the frequency of the research results of Wasisto et al [5]. As a comparison, one type of gamelan was chosen to be compared, the choice of researchers fell on Saron Demung. The frequency value of the results of this study can be said to be lower than the results of the study of Wasisto et al. The comparison is shown clearly in Table 2.

Table 2 Comparison of gamelan reni with the research of Wasisto et al

Wilahan	**Frequency (HZ)**		
	Research	**Wasisto et al**	**Difference**
1	284.6	299	14.4
2	304.2	320	15.8
3	327.23	347	19.8
4	386.16	406	19.84
5	413.93	440	26.1
6	436.6	470	33.4
7	495.3	519	23.7

3.4 Physical Size of Reni's Gamelan

In addition to testing the frequency, the researcher also measured the size of the gamelan Reni, this was for documentation purposes in the form of physical measurements used to complement the data about gamelan frequencies. Because the difference in the size of the gamelan will distinguish the resulting frequency.

Figure 6 Gamelan measurement process

In this journal, the physical size data displayed is only a small part considering that the research focus is more on the frequency of the gamelan, while the physical size of the gamelan is only used as a complementary document if the data is needed to produce it. a gamelan which is an adaptation of the gamelan by Reni. . The following is the physical size data for the gamelan gong and kempul

Table 3 The physical size of the gong and kempul by Reni

No	Tool	Dimensions
1.	Gong	*Raen* : 85 cm *Godhong* : 16 cm Back : 70 cm *Laras* : 19 cm *Pencon* : 16 cm
2.	Kempul	*Raen* : 50 cm *Godhong* : 11 cm Back : 41 cm *Laras* : 30 cm *Pencon* : 11 cm

4. Conclusion

Based on the results of research on the characteristics of the frequency and physical size of Reni's gamelan, it can be concluded that:

a. Laras Pelog gamelan sound spectrum shows the maximum amplitude in the frequency range 103.63 - 1978.83 Hz.
b. The accuracy of Da Tuner software for measuring the resonant frequency of the Pelog Reni tuned gamelan ((Δf0) is 5 Hz..
c. The factors that affect the resonant frequency (f0) of the gamelan according to Reni Laras Pelog are the width and thickness of each gamelan. Besides, the size of the resonator hole also affects the resulting resonant frequency (f0).

5. Acknowledgement

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